OPTICALLY TRANSPARENT MAGNESIUM OXIDE

J. E. Niesse

Department of the Air Force
Washington, D.C.

21 December 1973

Ser. No. 427,288

Filing Date 21 Dec 73

Inventor J. E. Niesse

NOTICE

The Government-owned invention described herein is available for licensing. Inquiries and requests for licensing information should be addressed to:

DEPARTMENT OF THE AIR FORCE
AF/JACP
Washington, D.C. 20314

OPTICALLY TRANSPARENT MAGNESIUM OXIDE

ABSTRACT OF THE DISCLOSURE

A method for forming an optically transparent magnesium oxide polycrystalline body by hot pressing a powdered mixture of lithium fluoride and magnesium oxide. The lithium fluoride is present as a densification aid in an amount of 0.3 percent by weight.

BACKGROUND OF THE INVENTION

The present invention relates to optically transparent magnesium oxide and to a method for its preparation. More particularly, this invention concerns itself with a method for producing a homogeneous polycrystalline body of optically transparent magnesium oxide under low pressures and temperatures from magnesium oxide powder.

The utilization of transparent polycrystalline bodies of magnesium oxide has long been of importance because of its desirable transmitting characteristics and its resistance to thermal shock. It finds use as a substrate material for optical detectors and as windows for missiles and other devices involved in infrared optics. However, the utilization of these bodies has not reached its highest potential because the polycrystalline

materials do not possess optical properties of a degree sufficiently high to justify their full utilization.

With the present invention, however, it has been found that polycrystalline magnesium oxide bodies can be produced at low temperatures and pressures by a method that employs lithium fluoride as a densification aid during the hot pressing of magnesium oxide powders. The homogeneous polycrystalline body fabricated in accordance with this invention possesses a high total transmission of from 75 to 80 percent coupled with a haze or diffuse transmission of only 5 to 6 percent for a body about 1/4 inch thick.

SUMMARY OF THE INVENTION

In accordance with the broad concept of this invention, as optically transparent magnesium oxide consisting of a homogeneous polycrystalline body can be fabricated by hot pressing magnesium oxide powders with the aid of a litnium fluoride densification agent. The lithium fluoride is added to a batch of magnesium oxide powder prior to hot pressing in amounts of 0.3 percent by weight.

Accordingly, the primary object of this invention is to provide a method for hot pressing magnesium oxide powder at relatively low temperatures and pressures in order to produce a polycrystalline magnesium oxide body.

Another object of this invention is to provide a method for producing homogeneous, polycrhstalline bodies of magnesium oxide that possess a high degree of optical transparency coupled with a low degree of haze or diffuse transmission in the visible range.

Still another object of the invention is to provide a

method that utilizes very small amounts of lithium fluoride as a densification aid in the fabrication of hot pressed magnesium oxide crystalline bodies.

The above and still further objects and advantages of the present invention will become more readily apparent upon consideration of the following detailed description thereof.

<u>DESCRIPTION OF THE PREFERRED EMBODIMENT</u>

The present invention is predicated upon the discovery that lithium fluoride can be employed as a densification agent in aiding the formation of a homogeneous polycrystalline magnesium oxide body during the hot pressing of magnesium oxide powder. Preferrably, the lithium fluoride is added to the magnesium powder prior to hot pressing in an amount of 0.3 percent by weight of the magnesium oxide powder. The lithium fluoride and magnesium oxide in powdered form are mixed together in conventional mixing equipment for about one hour at room temperature. A batch of the mixture is then placed in a conventional compression molding apparatus and hot pressed at pressures consistent with mold stock graphite. This allows for a low molding pressure of about 4000 psi at temperatures of from 1000 to 1100°C for a period of about 2 hours. The pressed product is then annealed at 1000°C for 60 hours in flowing hydrogen which develops its transparent properties.

Any conventional compression molding apparatus may be utilized in hot pressing the powder mixture. The mixture is that will [illegible] into a molding element of any suitable configuration ture of the mold is body of predetermined shape. The temperaheating element and thermocouple by means of a suitable electric suitably heated to a temperature of 1000°C, [illegible] When the mold is [illegible]pplied to

the mold, usually by a hydraulic press arrangement, and the pressure is raised to 4000 psi. This pressure is maintained for two hours while the trmperature is maintained at between 1000°C and 1100°C. The hot pressing procedure is conducted under inert conditions such as in an argon atmosphere or under a high vacuum. At the end of the pressing period, the heating element is shut off and the pressure slowly released to ambient conditions. The resultant polycrystalline body is then removed from the molding apparatus and placed in a conventional annealing furnace where it is annealed for 60 hours at 1000°C in flowing hydrogen.

The magnesium oxide polycrystalline product fabricated in accordance with the procedure described above possesses the highest optical properties presently attainable for large size crystals. A 75 to 80 percent total transmission and a 5 to 6 percent haze in the visible range were shown for crystals about 1/4 inch thick. After annealing in hydrogen, the residual lithium fluoride content was found to be less than 0.1 percent while, prior to annealing, the residual lithium fluroide content was found to be 0.2 percent by quantitative emission spectroscopy.

Although the present invention has been described with reference to a preferred embodiment, those skilled in the art will readily understand that various modifications and alterations thereof may be resorted to without departing from the spirit and scope of the invention, and that all such modifications as fall within the scope of the appended claims are intended to be included herein.

What is claimed is: